

# Water Flow Charts—2000

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## Background and Source of Data

Lawrence Livermore National Laboratory has since the 1970s produced flow charts and reports showing energy consumption in the United States and California. (All are available on the Web at <http://eed.llnl.gov/flow/>.) We have recently developed flow charts in a similar format to show water withdrawals, sources, and use, based on estimates developed by the U.S. Geological Survey. The USGS has compiled such estimates at 5-year intervals since 1950. Our current charts—and the most recent USGS estimates—show water use for 2000. (All figures are at the end of the text.)

These charts show the estimated withdrawal of fresh surface water and fresh ground water by various user sectors, all compared on the common basis of million gallons of water per day (Mgal/day). The width of the colored lines and boxes on the charts are proportional to the amount of water. (Exception: lines showing extremely small amounts have been made wide enough to be clearly visible.) As a consequence of independent rounding, the sums of individual rounded numbers may not equal the totals.

The water quantities shown in these 2000 charts were taken from a U.S. Geological Survey publication (cited here as USGS 1268):

Hutson, Susan S.; Barber, Nancy L.; Kenny, Joan F.;  
Linsey, Kristin S.; Lumia, Deborah S; and Maupin, Molly  
A. *Estimated Use of Water in the United States in 2000*.

Circular 1268. Reston, VA: U.S. Geological Survey, 2004.  
This publication is available on the Web at  
<http://water.usgs.gov/pubs/circ/> .

The estimates used in the flow charts came from tables in the USGS publication. The USGS tables include data for each of the 50 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands. The U.S. and state flow charts derived from estimates in the following USGS tables:

- Table 1, Total water withdrawals by source and state, 2000. (USGS 1268, p. 6)
- Table 2. Total water withdrawals by water-use category, 2000. (USGS 1268, p. 7)
- Table 3. Surface-water withdrawals by water-use category, 2000. (USGS 1268, p. 8)
- Table 4. Ground-water withdrawals by water-use category, 2000. (USGS 1268, p. 9)

The 2000 charts show freshwater withdrawals and use only. However, information about saline water withdrawals and use is included in many of the USGS tables, because 24 states also withdrew saline water. Saline water represented about 15% of U.S. total water use in 2000.

To simplify the graphic presentation, the charts group some of the end-use categories designated by USGS. Industrial use has been combined with mining; and irrigation, livestock, and aquaculture have been grouped together.

The USGS's 1995 estimates spelled out water deliveries from "public supply" to other user categories; however, the 2000 USGS estimates do not include this information.

## The U.S. and State Charts

As Figure 1 shows, the United States withdrew about 345,000 Mgal/day of freshwater in 2000. In addition, during the same year the United States withdrew 62,300 Mgal/day of saline water, for a total estimated withdrawal and use of 408,000 Mgal/day of water.

Figures 2 through 5 show freshwater withdrawals for the four states that withdrew the largest amount of freshwater in 2000: California (38,400 Mgal/day), Texas (24,800 Mgal/day), Idaho (19,500 Mgal/day), and Illinois (13,700 Mgal/day). Together, these four states accounted for almost 28% of U.S. freshwater use in 2000. (For consistency, the charts for these four states have been drawn on the same scale; the U.S. chart uses a different scale.) Figures 2 through 5 also illustrate the wide variations in water sources and use among these states.

Table 1, below, shows the top 12 states in terms of freshwater withdrawals in 2000 and indicates each state's percentage of the total U.S. freshwater withdrawals. Table 1 also gives each state's total water withdrawal (i.e., fresh and saline), percentage of U.S. total water withdrawal, population, and percentage of U.S. population.

Because of LLNL's interest in regional resource issues, Figures 6–8 show estimated freshwater withdrawals in 2000 for

Arizona (6,720 Mgal/day), New Mexico (3,260 Mgal/day), and Nevada (2,810 Mgal/day). Along with California, these three states are experiencing high population growth.

According to the U.S. Census Bureau's projections of population change from 1995 to 2025, California ranks first in projected population growth, with an estimated increase of 56.% during that period; New Mexico ranks second at 55.0%; Arizona ranks third at 52.0%; and Nevada ranks fifth at 51.1%. For comparison, the U.S. population as a whole is projected to grow 27.5% during that period. (U.S. Census Bureau, *Current Population Reports: Population Projections: States, 1995–2025*. Report P25-1131, 1997. Table 1, p. 4.)

Note that the Arizona, New Mexico, and Nevada charts are each drawn to the same scale, but that scale is four times larger than the one used for Figures 2–5. For example, a line denoting  $x$  Mgal/day of water is four times wider in Figures 6–8 than in Figures 2–5.

**Table 1. States with highest freshwater withdrawals, 2000, showing total water withdrawals and population.**

<b>State</b>	<b>Freshwater withdrawal (Mgal/day)</b>	<b>Percent of U.S. freshwater withdrawal</b>	<b>Total water withdrawal (Mgal/day)</b>	<b>Percent of U.S. total water withdrawal</b>	<b>Population (1000s)</b>	<b>Percent of U.S. population</b>
California	38,400	11.1	51,200	12.5	33,900	11.9
Texas	24,800	7.2	29,600	7.3	20,900	7.3
Idaho	19,500	5.7	19,500*	4.8	1,290	0.5
Illinois	13,700	4.0	13,700*	3.4	12,400	4.8
Colorado	12,600	3.7	12,600*	3.1	4,300	1.5
Nebraska	12,200	3.5	12,300	3.0	1,710	0.6
Ohio	11,100	3.2	11,100*	2.7	11,400	4.0
Arkansas	10,900	3.2	10,900*	2.7	2,670	0.9
Tennessee	10,800	3.1	10,800*	2.6	5,690	2.0
Louisiana	10,400	3.0	10,400*	2.5	4,470	1.6
Indiana	10,100	2.9	10,100*	2.5	6,080	2.1
Michigan	10,000	2.9	10,000*	2.4	9,940	3.5
Total of these 12 states	184,500	53.5	202,200	49.6	114,750	40.3
<b>U.S. Total</b>	<b>345,000</b>	<b>100</b>	<b>408,000</b>	<b>100</b>	<b>285,000</b>	<b>100</b>

Source: USGS 1268, Table 1, p.6.

\*No saline withdrawals.

## Thermoelectric Power Use

As shown on Figure 9, in 2000 an estimated 195,000 Mgal/day of water was withdrawn for thermoelectric power generation, which the USGS defines as generating electricity with steam-driven turbine generators. This represented almost 48% of all U.S. water withdrawals for the year. Almost 70% of this amount (or 136,000 Mgal/day) was freshwater, accounting for about 39% of all freshwater withdrawals. The remainder was saline water, almost entirely from surface water.

Table 2 shows the ten states that withdrew the most water for thermoelectric purposes in 2000.

**Table 2. Highest water withdrawals for thermoelectric power use, by state, 2000.**

State	Total water withdrawals (Mgal/day)	Freshwater withdrawals (Mgal/day)	Saline water withdrawals (Mgal/day)
Texas	13,300	9,820	3,440
California	12,900	352	12,600
Florida	12,600	658	12,000
Illinois	11,300	11,300	0
No. Carolina	9,470	7,850	1,620
New York	9,050	4,040	5,010
Tennessee	9,040	9,040	0
Ohio	8,590	8,590	0
Alabama	8,190	8,190	0
Michigan	7,710	7,710	0
<b>U.S. Total</b>	<b>195,000</b>	<b>136,000</b>	<b>59,500</b>

Source: USGS Circular 1268, Table 12, p.36.

The USGS also estimated thermoelectric water withdrawals by the type of cooling system used. Once-through cooling systems, in which the water is returned to the water source, represented 91% of withdrawal; and closed-loop systems, in which the water is recycled through the system, accounted for the remaining 9% of withdrawals. (USGS 1268, p. 35)

Although the USGS compiles information on saline groundwater used in geothermal power plants, that information was not included in their 2000 report. Also the water used in generating hydroelectricity, an “in-stream” use, was not included in the USGS estimates of water withdrawals. (USGS 1268, p. 35)

## Definition of Terms

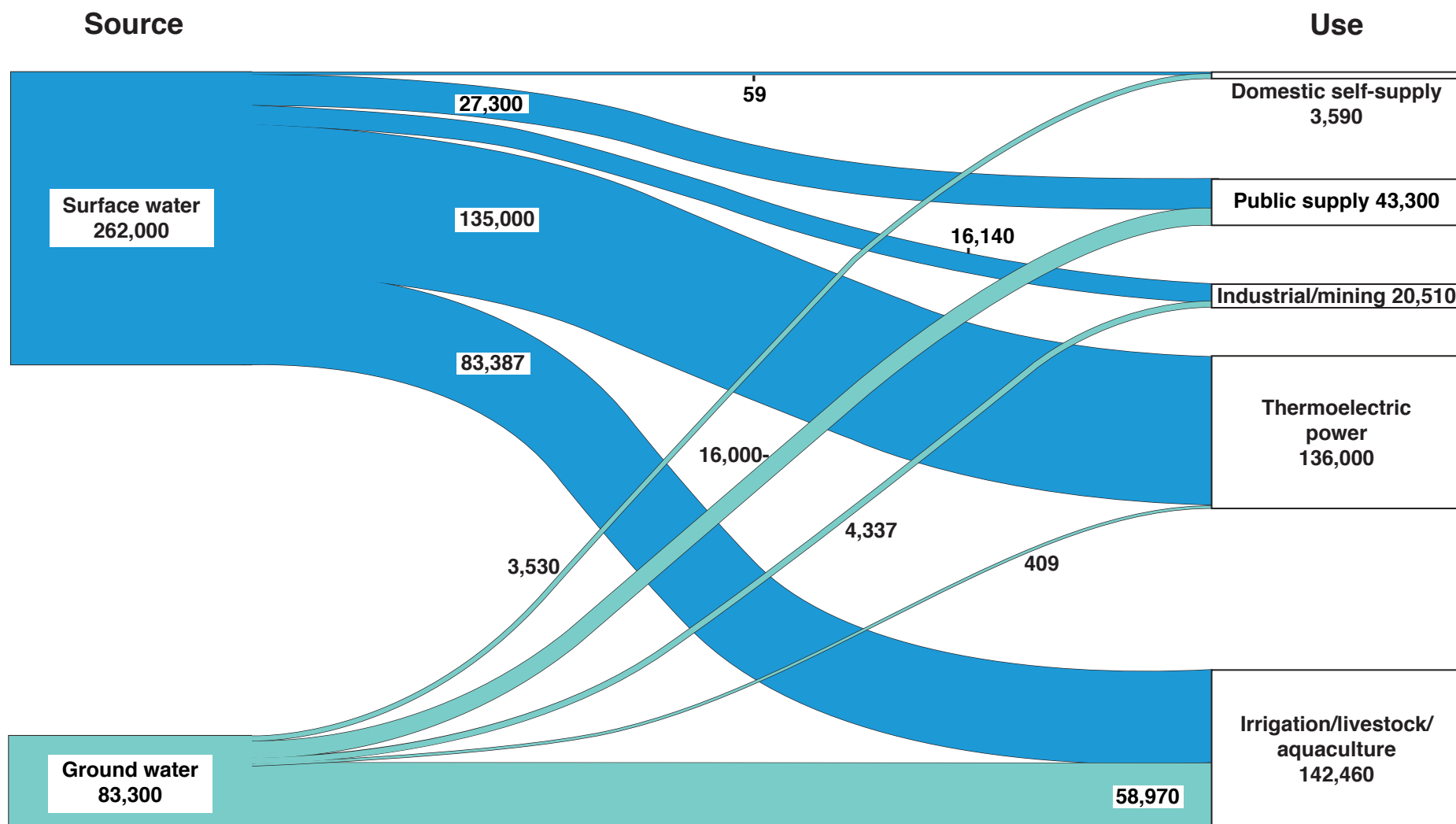
Most of the terms shown on these charts are defined by USGS in a glossary in the 2000 report (USGS 1268, pp. 44–46). A few of the definitions are briefly quoted here:

- ***Aquaculture water use:*** “water use associated with the farming of organisms that live in water...and offstream water use associated with fish hatcheries.”
- ***Closed-loop cooling system:*** “cooling systems where water is withdrawn from a source, circulated through heat exchangers, then cooled and recycled.”
- ***Freshwater:*** “water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids.”



- ***Once-through cooling system:*** “cooling systems in which the water is withdrawn from a source, circulated through the heat exchangers, and then returned to a body of water at a higher temperature.” Also called open-loop systems.
- ***Public supply water use:*** “water withdrawn by public and private suppliers that furnish water to at least 25 people or have a minimum of 15 connections.”
- ***Saline water:*** “water that contains 1,000 mg/L or more of dissolved solids.”
- ***Self-supplied water use:*** “water withdrawn from a ground-water or surface-water source by a user rather than being obtained from a public supply.”
- ***Thermoelectric-power water use:*** “water used in the process of generating electricity with steam-driven turbine generators.”

# Figure 1. Estimated U.S. Freshwater\* Withdrawals in 2000: ~345,000 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.

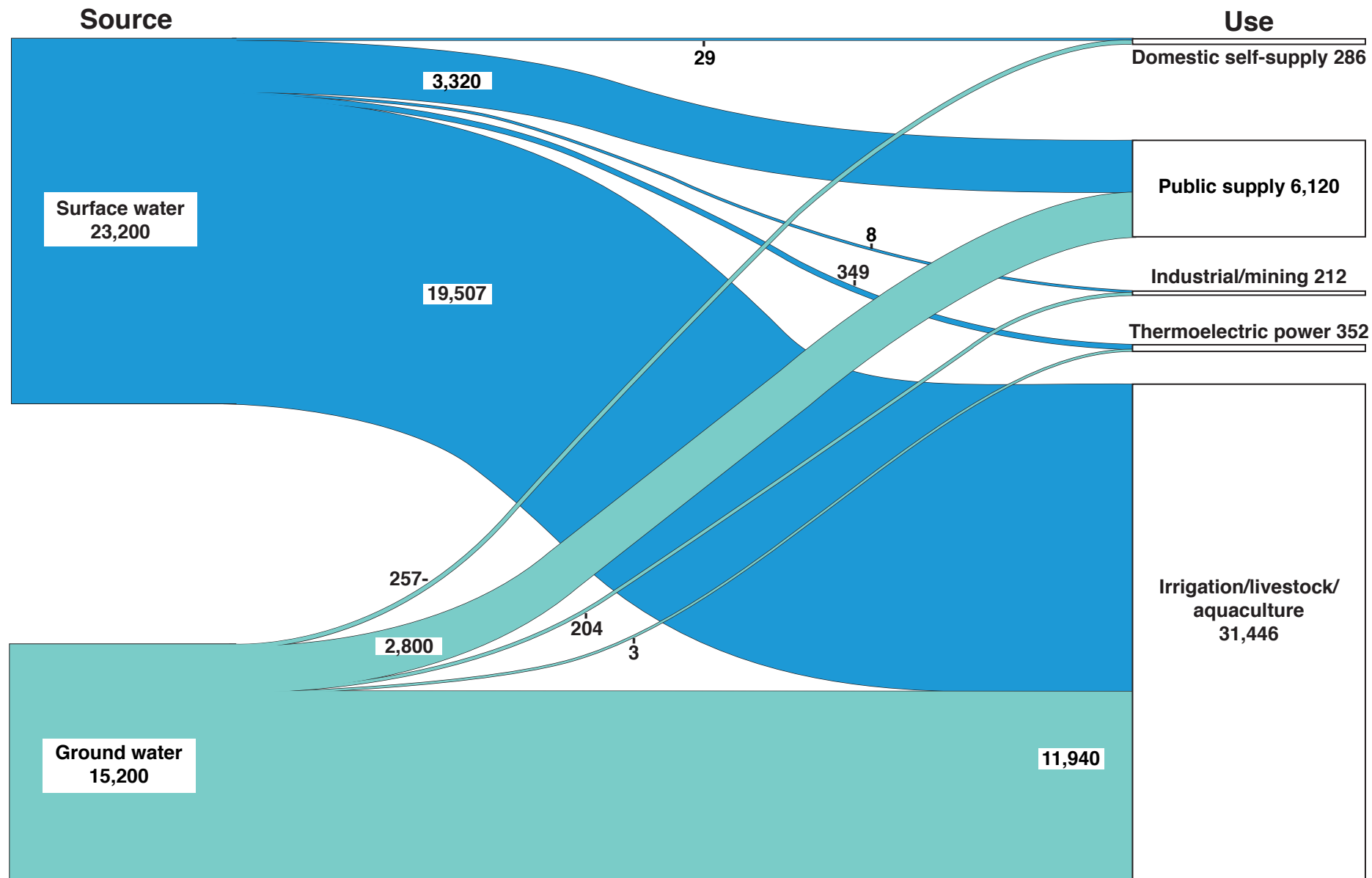
\*In addition, 62,300 Mgal/day of saline water was withdrawn, primarily for thermoelectric use.

Note: Numbers shown may not add to totals because of independent rounding.

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# Figure 2. Estimated California Freshwater\* Withdrawals in 2000: 38,400 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.

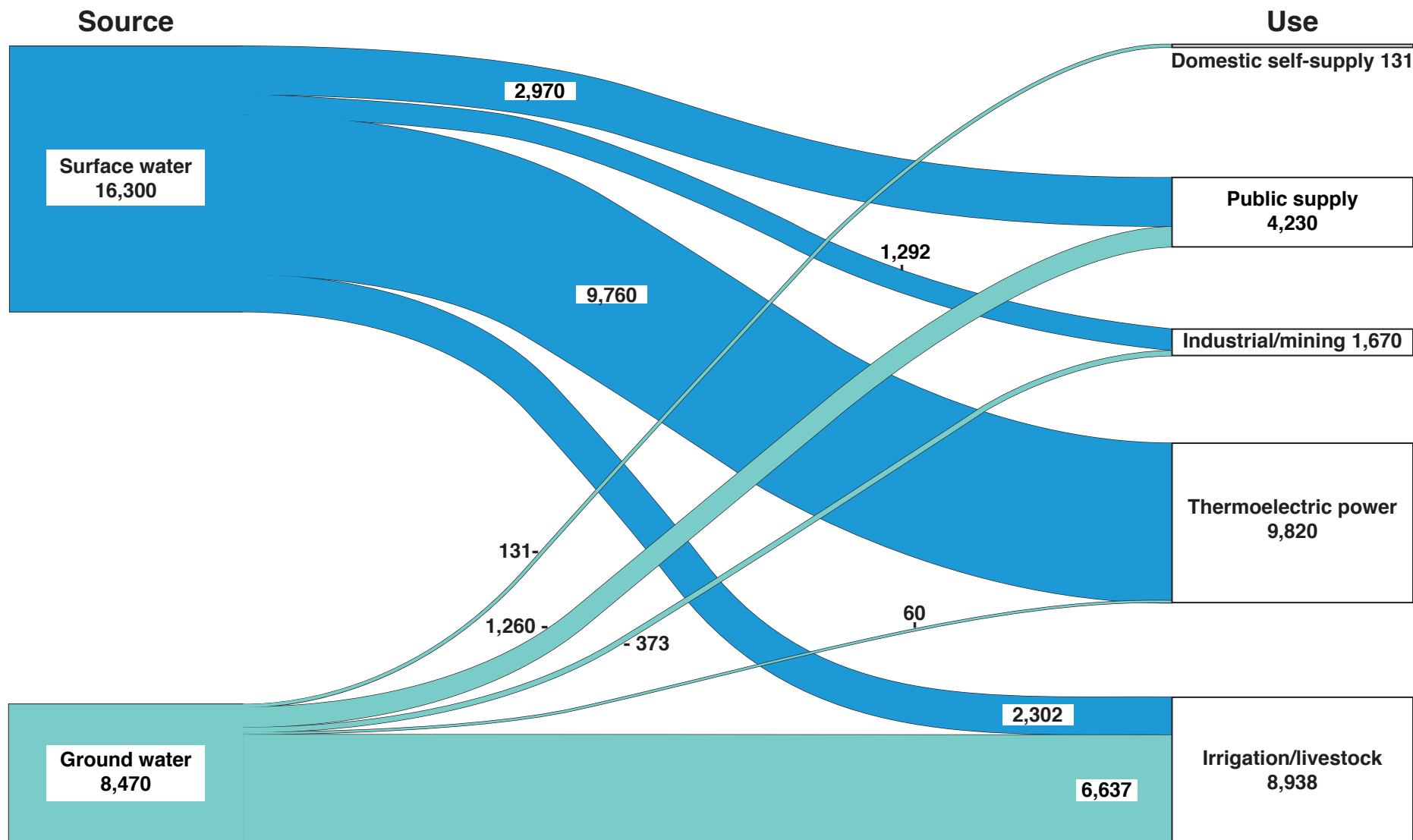
\*In addition, 12,800 Mgal/day of saline water was withdrawn, primarily for thermoelectric power purposes.

Note: Numbers shown may not add to totals because of independent rounding.

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# Figure 3. Estimated Texas Freshwater\* Withdrawals in 2000: 24,800 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.

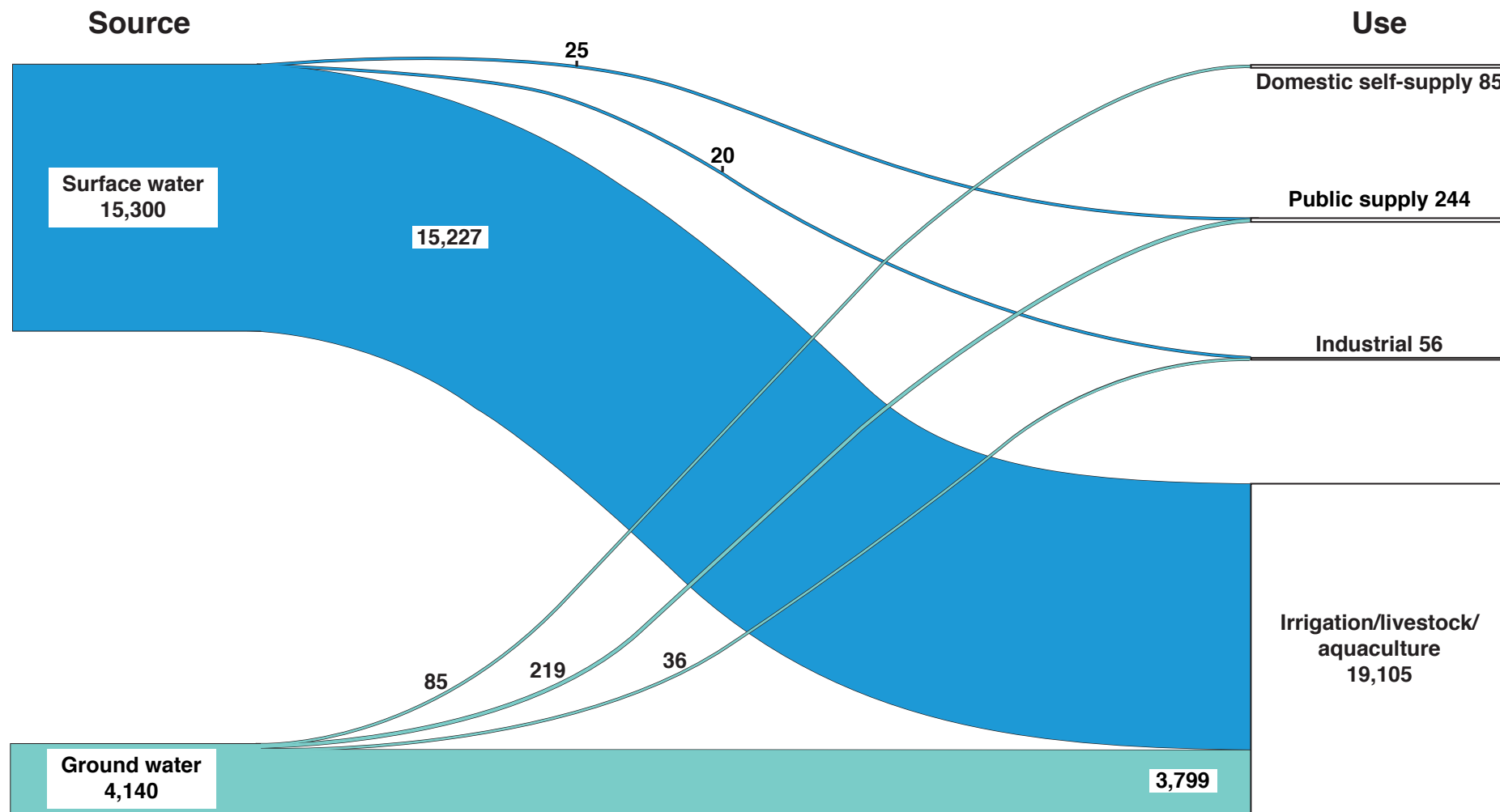
\*In addition, 4,850 Mgal/day of saline water was withdrawn, with 3,440 Mgal/day of that used for thermoelectric purposes and the remainder for industry and mining.

Note: Numbers shown may not add to totals because of independent rounding.

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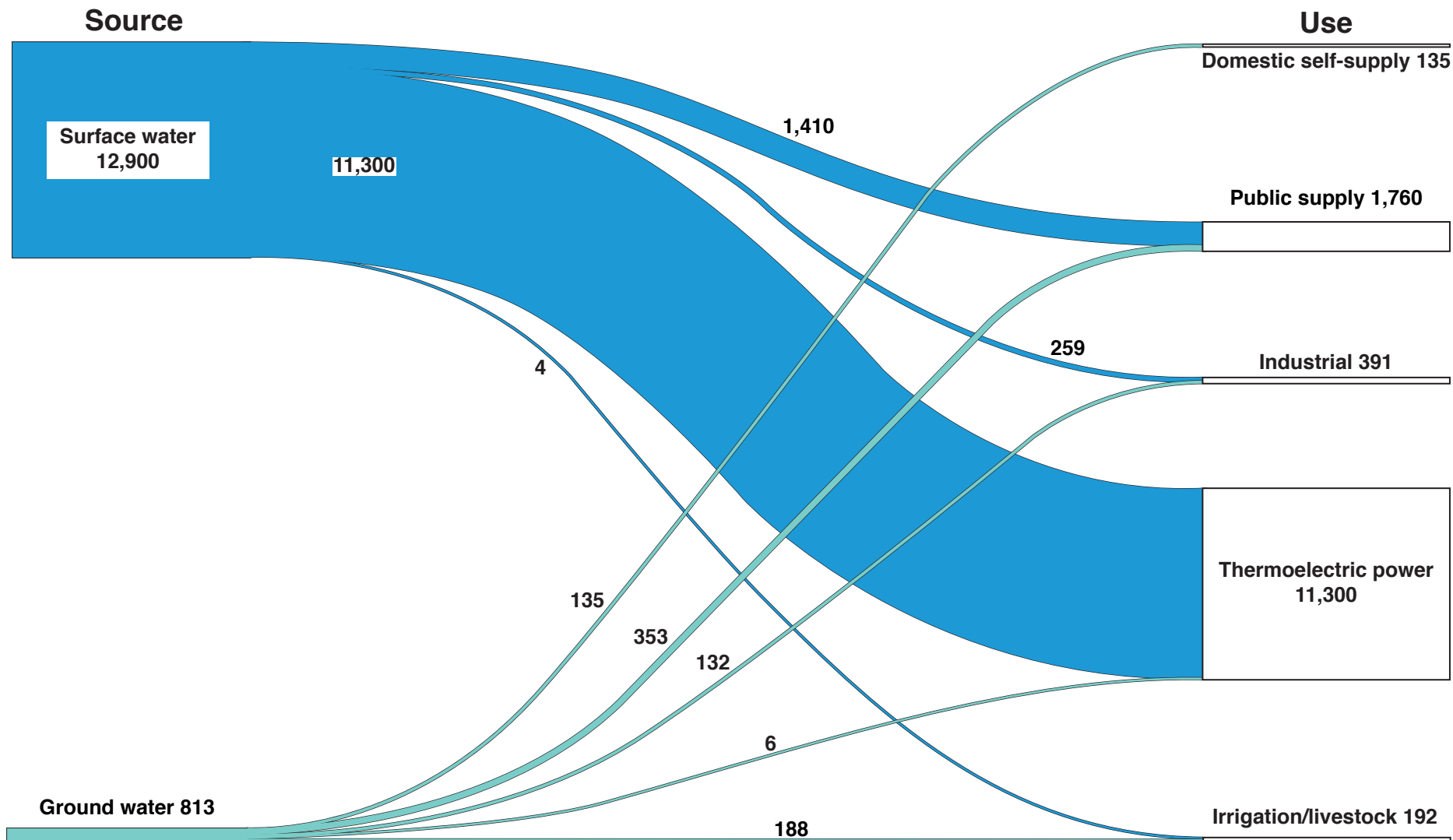
# Figure 4. Estimated Idaho Freshwater Withdrawals in 2000: 19,500 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.  
Note: Numbers shown may not add to totals because of independent rounding.

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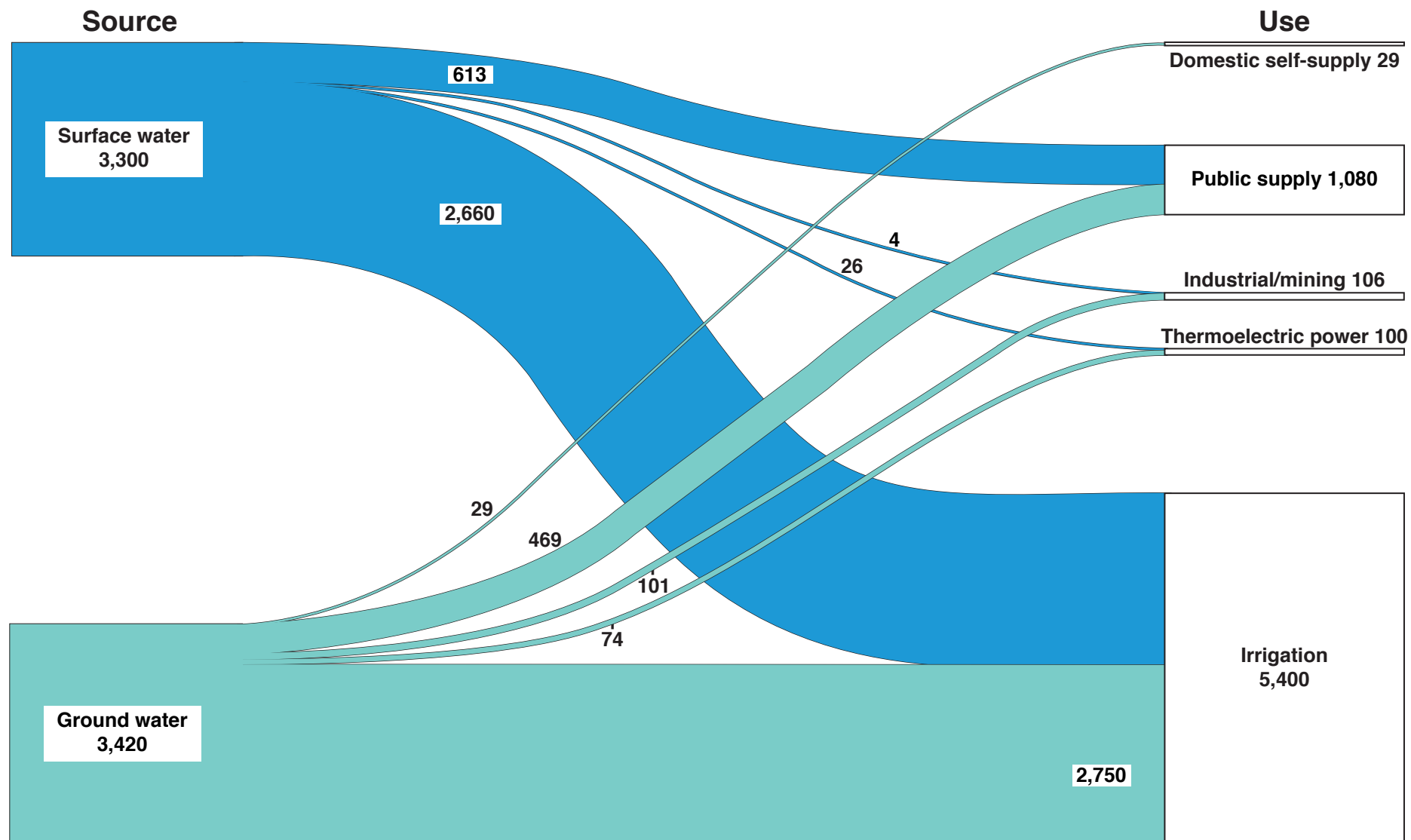
# Figure 5. Estimated Illinois Freshwater Withdrawals in 2000: 13,700 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.  
 Note: Numbers shown may not add to totals because of independent rounding.

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# Figure 6. Estimated Arizona Freshwater\* Withdrawals in 2000: 6,720 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.

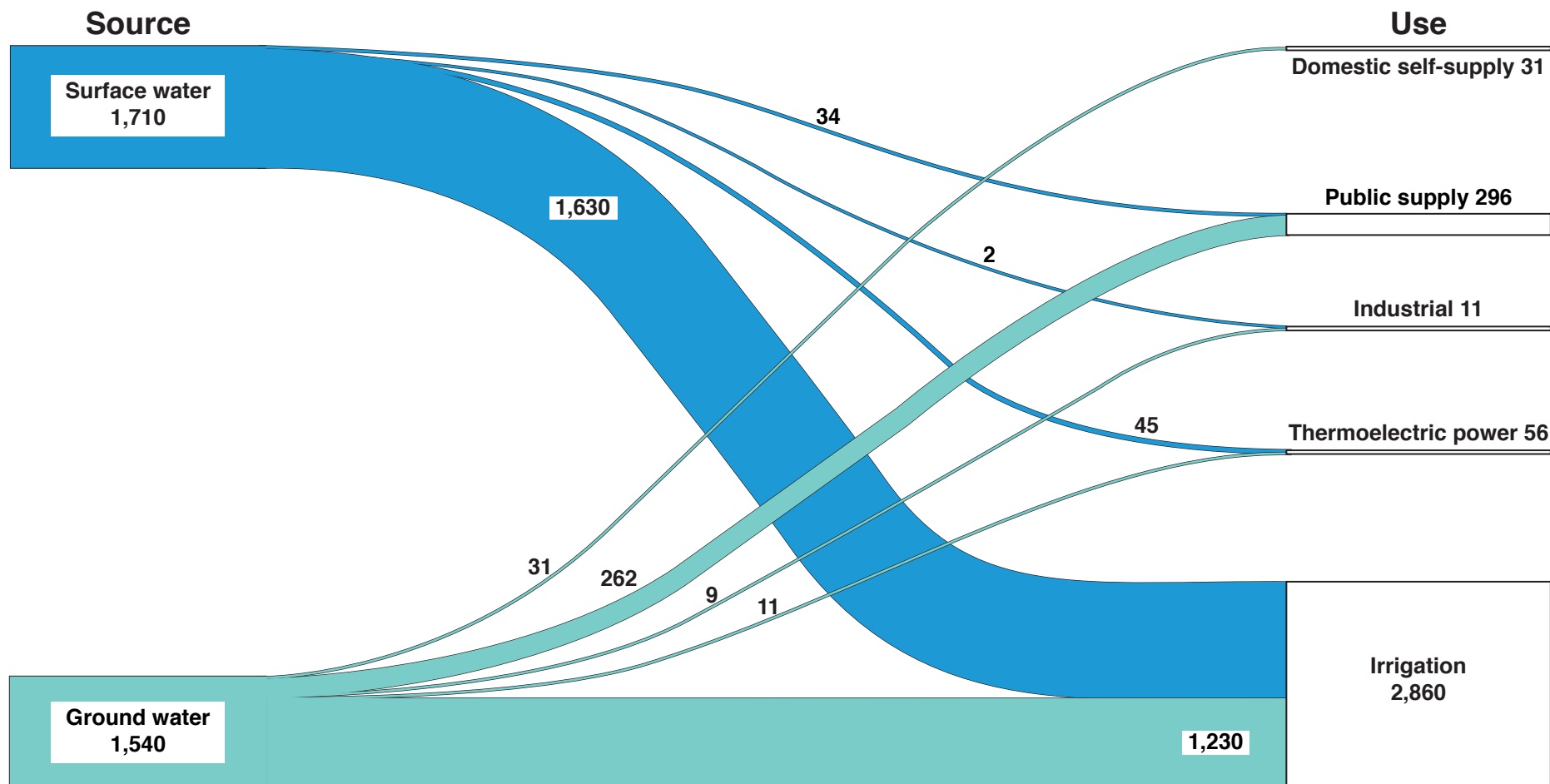
\*In addition, 8 Mgal/day of saline water was withdrawn for mining use.

Note: Numbers shown may not add to totals because of independent rounding.

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# Figure 7. Estimated New Mexico Freshwater Withdrawals in 2000: 3,260 Mgal/day

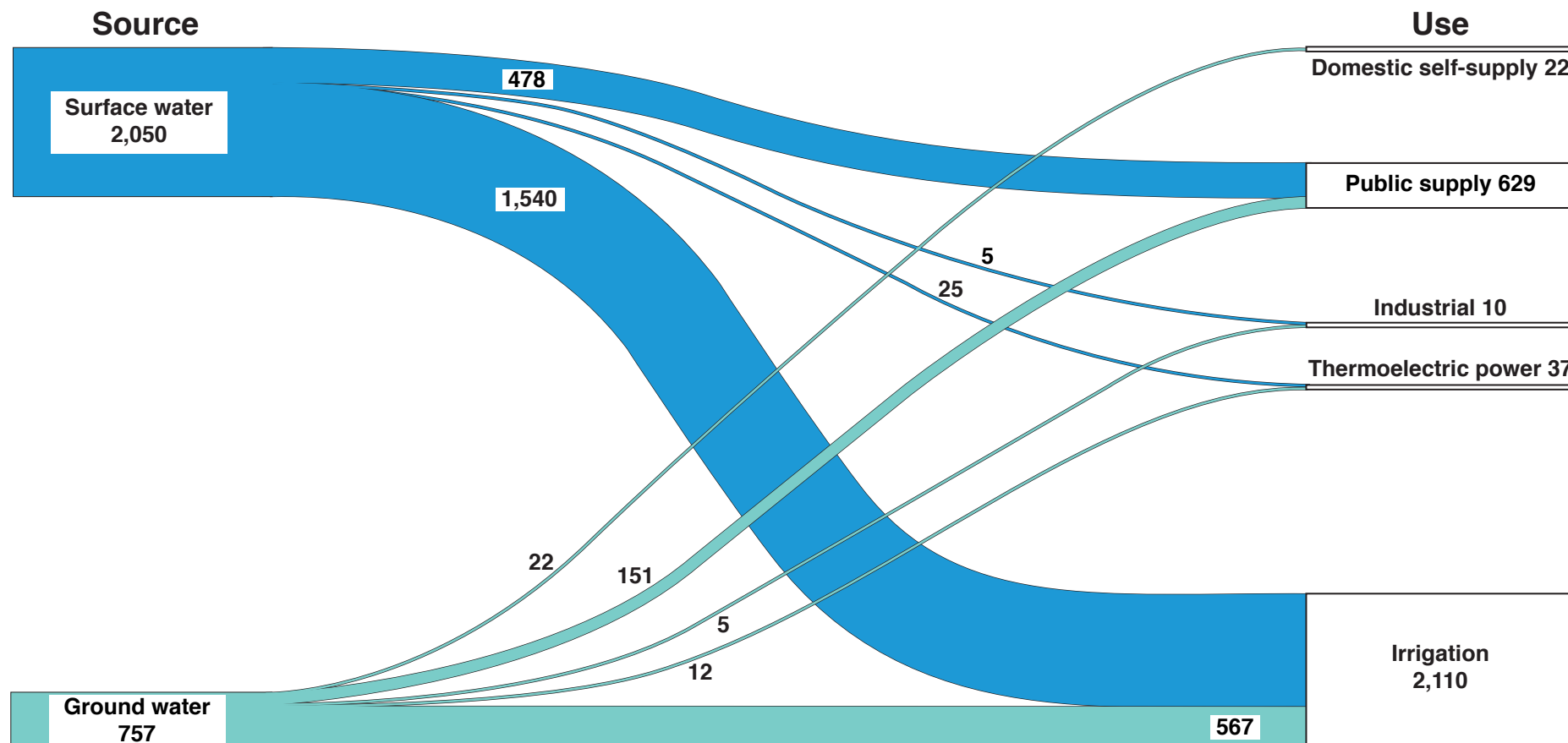


Source: U.S. Geological Survey, Circular 1268, Tables 1–4.  
Note: Numbers shown may not add to totals because of independent rounding.

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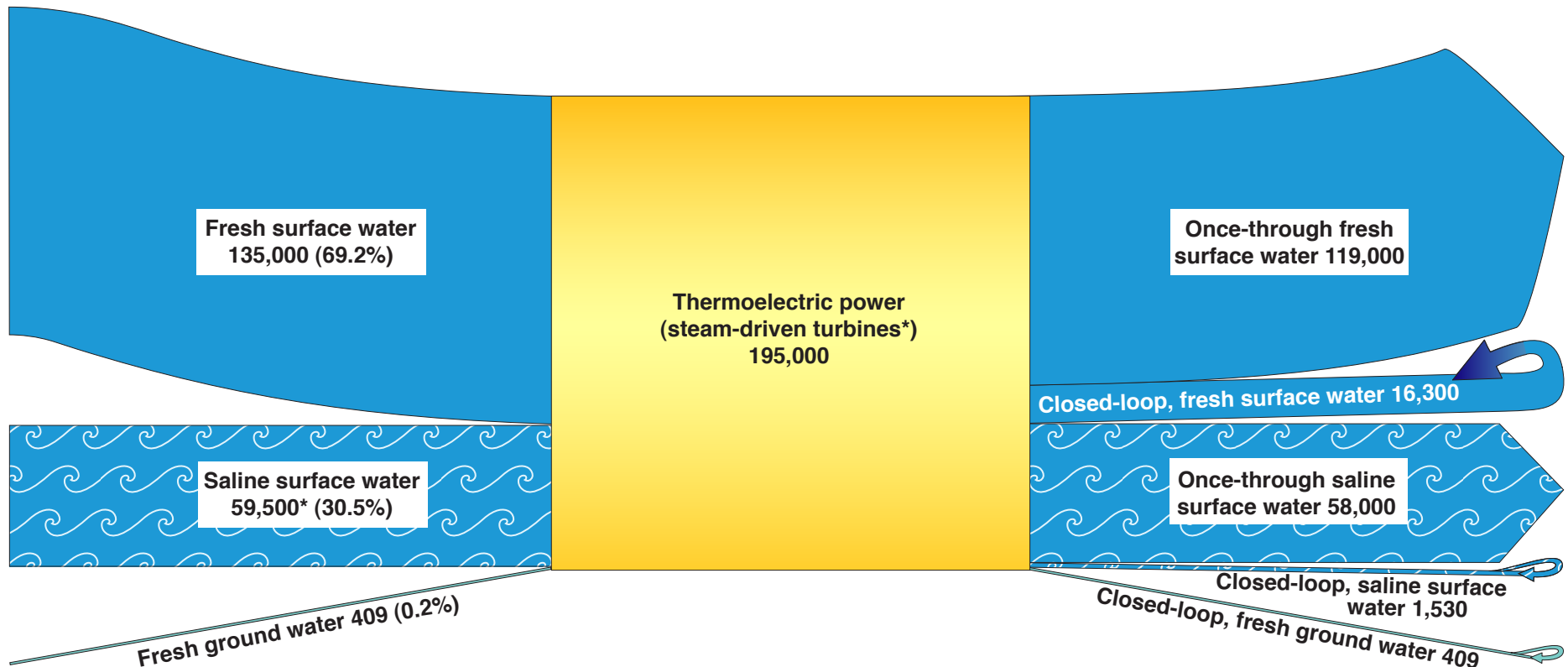
# Figure 8. Estimated Nevada Freshwater Withdrawals in 2000: 2,810 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 1–4.  
Note: Numbers shown may not add to totals because of independent rounding.

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## Figure 9. U.S. Fresh and Saline Water Withdrawals\* in 2000 for Thermoelectric Use: 195,000 Mgal/day



Source: U.S. Geological Survey, Circular 1268, Tables 12 and 13.

\*Does not include geothermal or the thermoelectric-power withdrawals for Hawaii.

Note: Numbers shown may not add to totals because of independent rounding.

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### **Web Locations and Credits**

The estimates shown in these charts was obtained from a U.S. Geological Survey publication: Hutson, Susan S.; Barber, Nancy L.; Kenny, Joan F.; Linsey, Kristin S.; Lumia, Deborah S; and Maupin, Molly A. *Estimated Use of Water in the United States in 2000*. Circular 1268. Reston, VA: U.S. Geological Survey, 2004. The USGS publication is available on the Web at <http://water.usgs.gov/pubs/circ/> .

Since the 1970s, Lawrence Livermore National Laboratory has prepared flow charts and reports on energy consumption in the United States and California. These are on the Web at <http://eed.llnl.gov/flow/> .

Graphic Artist: Helen Magann

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